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ABSTRACT

The object of this program was to develop and evaluate an improved portable video system for use as an instructional software design tool. The product developed was a basic configuration of half-inch video equipment using a three-camera system augmented with battery-powered recorder cameras. The combined hardware and manuals allowed the researcher to interact with the material being developed with a minimum of interference from photo-electronic operations. This project demonstrated that it is practical for writers to use sophisticated and complex half-inch video systems to facilitate the development of instructional materials. The usability, reliability, and maintainability is adequate to enable a researcher who is not a trained electronic or photographic technician to use the equipment without undue curtailment or restrictions imposed by the electronics and media production techniques involved. This maximizes the attention to content and instructional methodology and facilitates revision based on initial tryout of prototypic instructional sequences. The material in this volume summarizes the method of selection developed and the evaluative procedures employed. (JK)

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AFHRL-TR-72-65

AIR FORCE HUMAN RESOURCES LABORATORY

DEVELOPMENT OF A VIDEO SYSTEM FOR RAPID GENERATION OF LEARNING SEQUENCES

By

William J. Pieper
Applied Science Associates, Inc.

Edgar A. Smith

TECHNICAL TRAINING DIVISION
Lowry Air Force Base, Colorado

July 1972

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AIR FORCE SYSTEMS COMMAND

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AIR FORCE SYSTEMS COMMAND
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FOREWORD

The work reported here represents a portion of the research program of Project 1121, Technical Training Development; Task 112101, Advanced Technology for Air Force Technical Training. Dr. Marty R. Rockway was the Project Scientist and Dr. Edgar A. Smith was the Task Scientist.

This report has been reviewed and is approved.

George K. Patterson, Colonel, USAF
Commander

ABSTRACT

The objective of this program was to develop and evaluate an improved portable video system for use as an instructional software design tool. The initial system was designed for use by personnel engaged in research and development in training techniques. It greatly increased the effectiveness and reduced the cost of producing experimental audio-visual materials (e.g., slides, movies, etc.) by providing increased flexibility in scripting, editing, and content review prior to hard copy and permanent recording.

SUMMARY

Pieper, W. J., & Smith, E. A., DEVELOPMENT OF A VIDEO SYSTEM FOR RAPID GENERATION OF LEARNING SEQUENCES. AFHRL-TR-72-65. Lowry AFB, Colo: Technical Training Division, Air Force Human Resources Laboratory, July 1972.

Problem

The objective of this program was to develop and evaluate an improved portable video system for use as an instructional software design tool. The system was designed for use by personnel engaged in research and development in training techniques who are not specifically trained in the techniques of photography or production methodology.

Approach

A basic configuration of half-inch video equipment utilizing a three camera system augmented with battery-powered recorder cameras was developed. The combined hardware and manuals allowed the researcher to interact with the material being developed with a minimum of interference from photo-electronic operations.

Results

The material reported in this volume summarizes the method of selection developed and the evaluative procedures employed. A supplemental visual insertion unit was developed in-house to facilitate the inclusion of graphic materials. The resultant configuration does enable a researcher or writer to rapidly generate prototype and experimental training materials with a minimum of interference from electronic and/or photographic requirements. The additional three manuals are required for the utilization of the system but will not be published since they are specific to this particular application and setting.

Conclusions

It is practical at this time for writers to employ sophisticated and complex 1/2 inch video systems to facilitate the development of instructional materials. The useability, reliability, and maintainability is adequate to enable a researcher who is not a trained electronic or photographic technician to employ the equipment without undue curtailment or restrictions imposed by the electronics and media production techniques involved. This maximizes the attention to content and instructional methodology and facilitates revision based on initial tryout of prototypic instructional sequences.

This summary was prepared by Ronald H. Filinger, Technical Training Division, Air Force Human Resources Laboratory.

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SECTION I

INTRODUCTION

Problem

At present, the generation and revision of material for experimental learning sequences is written, printed, and evaluated in document or film form, then rewritten, reprinted, or rephotographed for re-evaluation. Written or printed materials examined out of the context of the dynamic instructional presentation do not provide the level of awareness required to adequately evaluate the effect of a learning sequence. While slides or motion pictures allow for review and revision, both are costly in terms of processing delays, editing, and materials. Since filmed material is costly to revise, there is a tendency to retain filmed sequences which are known to be less than optimal and, in some cases, ineffective.

Moreover, conventional production methods tend to involve phototechnologists and audio-visual specialists. Communication between specialized personnel accounts for the majority of time and money required in the development of experimental instructional learning sequences. The bulk of technical training information is so involved that valuable time is lost explaining specifics to writers, illustrators, and cameramen, so that they may perform their duties. This process tends to increase project time with endless rewriting, editing, and script approval meetings.

When dealing in the development, demonstration and evaluation of technical training methods and media, rapid generation and quick reaction of video portions is critically important. Video tape allows instructors or experimenters to construct instructional sequences rapidly, record audio and video simultaneously, playback, and revise as necessary. All of these actions are possible without processing delays or additional materials costs. These requirements are prerequisite for optimal utilization of idea development and are possible only by maintaining maximum instructor or experimenter control over media use.

Such a video system must also provide for ease in configuration such that minimal time is spent in setup and operations, and by a minimum of

nontechnical individuals. Training requirements often dictate learning environments away from conventional academic areas (in the field, at a flightline station, etc.) and such a system must be versatile enough to be transportable where and when needed to capitalize on idea development.

Recent developments in video tape recording have made this medium feasible for use in the development cycle of learning sequences. Standardization of recording/playback requirements has occurred, and smaller and more economical cameras and recorders are being engineered with the durability and reliability previously found only in larger studio equipment. Simplified and standardized controls and operation/maintenance procedures further reduce the operational complexity and minimize the special skills required to produce video recordings. Off-the-shelf equipment is now available with capabilities to meet a broad spectrum of user requirements. The problems facing the user are to:

1. define the specific video components and system configuration which are most cost-effective in accomplishing this application, and

2. develop techniques for installing, operating, and maintaining the video system.

The intent of this development effort was to design and assemble a video system uniquely configured to facilitate the rapid generation of instructional materials. This report is the final project report and deals with the identification of video components and the development of system configurations to be used for the generation of experimental learning sequences. In addition, the development of installation, operation, and maintenance techniques for system utilization are described. The installation, operation, and procedures developed for this specific video system were reported in three unpublished system specific manuals which can be obtained from the Air Force Human Resources Laboratory, Lowry Air Force Base, Colorado.

Approach

The source data on the applications for a video system, on which the system configurations and tryout were based, was obtained largely from the Human Resources Laboratory (HRL). The laboratory at Lowry Air Force Base employs instructional materials development procedures typical of other materials development activities including other branches of HRL and technical schools throughout the Air Force. Development of a video system for rapid generation of learning sequences including the capability

for content approval reviews, material tryout, and content revision was accomplished in six phases:

Phase I - Video Application Analysis

Phase II - Equipment Identification

Phase III - Format and Equipment Evaluation

Phase IV - Component Selection

Phase V - System Configurations

Phase VI - System Tryout.

The six phases were performed in the indicated sequence, with the output of each preceding phase serving as the input to the next phase.

The applications analyzed in Phase I included not only the application of generating instructional materials, but also other studio and field applications (e.g., professional presentations) for which the video system might be used. The analysis was conducted to determine the number and types of operators and their characteristic equipment sophistication, types of subjects to be recorded, conditions under which they would be recorded, and characteristics of the recorded material including the special effects desired. Analysis of the current and anticipated applications resulted in a set of video system functional characteristics requirements.

During Phase II, Equipment Identification, commercially available equipment items which satisfied the functional characteristic requirements for the specific equipment type (e.g., cameras, video recorders, etc.) were identified for evaluation. Equipment items were identified for three video tape formats:

1. One-half inch monochrome
2. One inch monochrome
3. One inch color

Equipment items were identified for three video tape formats to permit the evaluation of both tape format and equipment items for suitability to the video system applications.

In Phase III, Format and Equipment Evaluation, equipment items in the three tape formats were evaluated on the basis of reproduction quality, tape interchangeability across manufacturers, equipment operability, equipment versatility, and equipment maintainability. The evaluations were conducted in operational environments to determine the video tape format and equipment items within that format that best satisfied the requirements of the video system applications. The outcome of these evaluations was a tentative list of equipment items to be obtained for system tryout.

Final selection of equipment to be obtained for the system tryout was made during Phase IV, Component Selection. Equipment items within type (e.g., cameras, recorders, etc.) were compared on the basis of cost and functional characteristics to select those items which would satisfy the functional requirements most cost effectively.

During Phase V, System Configurations, tentative configurations were developed for both studio and field system utilization. The operational capabilities of the selected equipment components were matched against the functional requirements to produce tryout system configurations which were versatile, easy to set-up, and easy to operate.

The tryout system configurations were evaluated and modified during Phase VI, System Tryout. All equipment items were combined in the planned manner, appropriate subjects were recorded, and recorded tapes were played and evaluated. Configurations were modified as required on the basis of playback evaluations and problems encountered during recording sessions. As a result of this effort, final equipment configurations were developed as well as proven techniques of system installation, operation, and maintenance.

This brief overview of the approach is provided for the orientation of the reader. The methodology and results of each phase are discussed separately in the next six sections of the report.

SECTION II

VIDEO APPLICATIONS ANALYSIS

Methodology

The principal methods for analyzing video applications were observation and interview. All previous applications of video equipment owned by the Human Resources Laboratory (HRL) at Lowry Air Force Base were examined, either by observing playback of tapes and/or by interviewing laboratory personnel concerning past applications. In addition, proposed new applications were discussed to identify desired uses not possible in the past. Applications such as professional presentations and "video letters" were considered in addition to applications for generating learning sequences to ensure a complete sample of all possible applications. For each application, the individuals interviewed were asked to identify the content of the video tapes, the subjects taped, the techniques used in preparing the tapes, and the application of the completed tapes.

Initially, the situational aspects of the recording and playback functions were identified separately for each application. This was done to orient the discussions to one set of requirements at a time. However, it became obvious after a very few applications were examined that the recording/playback dichotomy was unimportant, because the playback situations were very stable. The playback situations involved either a single viewer or a small group of viewers at each monitor. For either of these situations, the functional equipment requirements were identical.

The recording situations proved to be most easily and completely examined by considering the following situational characteristics for each application:

1. Location of equipment utilization
2. Subjects to be video taped
3. Number of equipment operators involved
4. Operations performed.

Locations

The locations were characterized and classified as (a) outdoors, (b) studio, (c) classroom, and (d) shop. These classifications were used to indicate the general ambient illumination levels under which recordings were to be made. Where overall illumination levels were similar, such as classroom and office or shop and hanger, the appropriate classification from the four listed above was used. The studio/non-studio dichotomy served another purpose, that of identifying which equipment functional characteristics were pertinent to portable equipment and which were limited to studio equipment.

Subjects

Subjects were classified as (a) people, (b) operational equipment, (c) video tape, and (d) slides and other visuals. This information served several purposes. The type of subject indicated the need for special equipment. For example, slides as a subject indicated the need for equipment to change slides into a video signal and video tape as a subject indicated a need for two tape recorders (one to play back prerecorded tape and another to record the playback). The range of subject sizes for a single application provided information on lens requirements (i.e., focal length, zoom ratio, etc.).

Operators

The number of operators required were one, and two or more. Where both one and two or more operators could be used, a brief description of the recording situation was noted for the two alternatives. This information identified the applications to be performed by a single operator and therefore the equipment required to be remotely controlled because the operator could not be in two places simultaneously. It also provided information regarding organization of equipment items in the system configurations.

Operations

The last category of information in the analysis was the operations performed by type of operator. In applications requiring more than one operator, the operations were differentiated by equipment operated. The dichotomy used was console operator-camera operator. The operator was designated a console operator if he operated video tape recorders, audio amplifiers, and special equipment controlling the information taped. The operator was designated a camera operator if he operated cameras, placed subjects for camera viewing, and/or arranged lighting. The operations

recorded were those dealing with video tape and not equipment manipulations (e.g., record live subjects, record slides, and add prerecorded material to master tape). The information on number of operators and operations performed indicated number of equipment components, component capabilities, and system configurations.

Procedures

All information obtained from the observations and interviews regarding location of equipment utilization, subjects, equipment operators, and operations performed was recorded on a simple four column form. The information recorded was as specific as possible (e.g., exact dimensions of subjects when known and subject characteristics such as stationary or moving). Informants providing general information were pressed for details to ensure as much detail as practicable.

When all anticipated applications had been examined, the listed information in each of the categories was summarized for the studio and field locations separately. For both locations, the maximum range of subject sizes and characteristics likely to be encountered in a single recording session was determined by examining the information listed on the forms. The total number of unique operations was determined next, including the frequency with which each operation was performed. Finally, the number of operators for each unique operation was taken from the standard forms. The resulting summary of subjects, unique operations, and number and function of operators for each operation identified most of the functional characteristics of the equipment components. Two additional categories of information had to be considered before these requirements could be finalized.

The first consideration was operator characteristics. Discussions concerning the identity of the individuals operating the video system revealed that the operators would be instructors, research personnel, etc. While these individuals would be professional trainers, they would be unskilled in the operation of video equipment. This identified the need for simple controls, automatic circuitry, standard and keyed connectors, etc. The second consideration was the interconnection of the system equipment components. To simplify system installation and to maximize the number of possible system configurations, equipment items had to be completely compatible. In addition, to ensure the simplest possible system configurations for each application, each equipment item had to be capable of independent operation. To prevent accidental damage to the system, all signals for interconnecting the system had to be standardized so an improper connection would not destroy the system. For example, cameras had to be capable of being connected directly to a monitor, a recorder, or a switcher without

the need for special signal converters or anything other than a cable. The considerations for operator characteristics and equipment interconnection were reviewed for each of the operations and operator combinations to determine whether any changes were required in the functional characteristics.

The summarized application information, operator characteristics, and equipment interconnection considerations were used to identify the types of equipment items, number of each item type, and functional characteristics of each item. For example, reviewing the number of subjects to be recorded at one time and the operations for combining video images indicated the number of cameras and the types of video switching equipment required. Applying the considerations of operator characteristics to the camera functional characteristics indicated which of the camera operations should be controlled by automatic circuitry and which should be controlled by the operator. Applying the considerations of equipment interconnection requirements to the camera functional characteristics indicated the video signal characteristics, and synchronizing signal characteristics. Functional characteristics requirements were listed for each of the required equipment items. This list constituted the system functional characteristics used to identify applicable equipment items.

Results

The video tape recording applications identified were:

1. Generation of learning sequences
2. Analysis of job performance
3. Testing job performance
4. Formal presentations
5. Informal "letters" to associates.

The above list is rank ordered according to the expected frequency of video system usage. For example, the video system would be used most frequently for the generation of learning sequences and least frequently for informal "letters" to associates. Although it was desirable to determine more precisely the relative usage of the system, this was not possible because video equipment is not currently being used by the Human Resources Laboratory in all of these applications.

A summary of the situational characteristics identified for each of the applications listed above are presented in Appendix A. The functional characteristics of the equipment to be used in a video system for generating experimental learning sequences are presented by type of equipment in Appendix B.

SECTION III

EQUIPMENT IDENTIFICATION

Methodology

Equipment to be evaluated was identified for the three most commonly used formats of video tape recording:

1. One-half inch monochrome
2. One inch monochrome
3. One inch color.

The equipment items for each of these tape formats were identified by searching equipment surveys such as the 1971 edition of The Audio-Visual Equipment Directory, catalogs of national suppliers, and specifications sheets from local equipment suppliers.

In identifying equipment items, the technical specifications for the equipment were considered in addition to the required functional characteristics. Technical specifications were matched across equipment items which would be used together. For example, the horizontal resolution of the cameras was matched to the recording capabilities of the video recorders and to the resolution of monitors. Frequency response characteristics were considered for both audio and video equipment, as was bandwidth of all processing equipment (e.g., special effects generators, amplifiers, and mixers). Functional characteristics of equipment were compared against the requirements developed during the applications analysis.

The utilization of equipment items in systems for more than one format of video tape recording was also considered. Monochrome cameras, monitors, and video processing equipment were identified to be included in the evaluation only if they could be used for both one-half and one inch monochrome recording. Identifying equipment items which could be used for all three formats was not possible because color and monochrome cameras, recorders, monitors, and processing equipment are quite different.

Recorder selection for one-half inch monochrome recording was greatly simplified because of a recent standardization in this format. The tape speed, methods of recording, and video recording characteristics have been standardized across manufacturers. Only those recorders which met the new standards were identified for evaluation. The tape speeds, method of recording, and video recording characteristics of one inch monochrome and color recorders had not been standardized. Therefore, only recorders manufactured by major American manufacturers were identified for evaluation in these formats. At the time of this evaluation, neither three-fourths inch cassette video recording equipment or instavideo equipment were available.

Results

The equipment lists for each format are given in Appendix C.

SECTION IV

FORMAT AND EQUIPMENT EVALUATION

Methodology

All equipment was evaluated in operational environments, and four equipment configurations were used:

1. One-half inch monochrome, one camera
2. One-half inch monochorme, three cameras
3. One inch monochrome, three cameras
4. One inch color, three cameras.

These four systems were used to record, playback, and edit video tape. The evaluation of the three systems utilizing more than one camera also included tryouts of special effects, duplicating, and recording and playback on a shoulder pack camera/recorder.

The evaluations conducted were designed to answer two questions:

1. Which tape format is most appropriate to the anticipated applications?
2. What equipment items in the selected format best satisfy the functional requirements?

Evaluation of the recording quality of one-half inch equipment was conducted in the following manner. Each equipment supplier provided a prerecorded five minute tape. The first minute of this tape showed a standard resolution chart. The next four minutes contained indoor and outdoor scenes which had been assembled from live and prerecorded material using each machine's editing capability. The tapes from all recorders were played back on each recorder to determine the ability of the various machines to playback video tapes recorded on other machines, as well as the video tape recorded on itself. Because of the incompatibility between one inch recorders, an evaluation of this type could not be

conducted for either one inch monochrome or one inch color formats. Recording and playback was evaluated on resolution, noise levels (snow), and edit quality.

In addition to picture quality, the equipment items were evaluated on ease of set-up, operability, maintainability, versatility, and portability. Ease of set-up was evaluated by determining the number of cable connections required for each equipment item, the method of connecting each cable, the possibility of confusing connectors, and whether or not the connectors locked. Ease of operation was evaluated by determining the number of controls operated and how many were automatic, the method of operating each control (rotation, linear movement, etc.), the possibility of confusing operation among similar controls on other equipment items (CW rotation to increase signal level as opposed to CCW rotation to increase signal level), and whether or not the controlled function had an indicator. Maintainability was evaluated by determining the number of preventive maintenance operations performed, the simplicity of each maintenance operation, the possibility of damaging the equipment if the operation was performed improperly, the seriousness of the possible damage, and the type of corrective action required to repair the damage. Versatility of equipment items was evaluated by determining the types of equipment and accessory mountings, the types of signal inputs and outputs, whether or not the inputs and outputs were standard levels and impedences, whether or not the equipment was color compatible, the distance signals could be sent over cables, and the number of other equipment items which could be supplied with signals. Finally, the portability of each item was evaluated by determining its weight, its physical dimensions or size, estimates of the time or difficulty for packing, and the number of containers required. All information was recorded on standard forms. The forms and details of the information recorded are presented in Appendix D.

Format Evaluation

Determination of the format most appropriate to the anticipated applications was based on the outcome of the picture quality, operability, and versatility evaluations of the equipment. Additionally, factors such as interchangeability of tapes across manufacturers and operator characteristics and equipment interconnections were considered. Format determination was based on the overall implications and not on any one factor.

Equipment Evaluation

After all information was recorded, the results were tabulated for each equipment item and the results for similar items were compared to select the items which scored highest overall. During this evaluation,

greatest weight was placed on picture quality, operability and maintainability. Lesser important factors were versatility, portability, and ease of set-up. Items selected for inclusion in the system were those which produced high quality video images, were easier to operate, were easier to maintain, were more versatile, had greater portability, and were easier to set-up. In some cases the choice among similar items was relatively easily made because one item was obviously superior to the alternate choices. In most cases, items were selected on the basis of tradeoffs among the categories and while one item was selected one or two others were identified as possible alternates.

Results

Format

The format selected by the Technical Monitor and the Principal Investigator as the one best suited to HRL requirements was one-half inch monochrome video tape recording. This selection was made because of the following primary deficiencies in the other formats:

1. No standardization of tape speed across manufacturers
2. No standardization of recording format across manufacturers
3. Recorders were more sophisticated and harder to operate for untrained personnel
4. Resolution (picture quality) was not noticeably greater than that of one-half inch equipment.

In addition, almost all picture improvements in one inch recordings over one-half inch recordings were in the area of broadcast requirements, an area which was not a prime factor in the anticipated video applications. The deficiencies listed above applied to both the monochrome and color formats. There was another problem in the area of color recording. No standard system of recording had been accepted by the equipment manufacturers. Some manufacturers used a pilot signal system, while others used a direct record system. Until some standardization occurs, tapes recorded on one manufacturer's machine would have to be played back on a similar machine from the same manufacturer. The same situation exists at present in one-half inch color recording; however, a standard is being considered for this format and the possibility of using this format should be investigated in the future.

Equipment

The list of one-half inch monochrome recording equipment judged most adequate in satisfying the functional requirements is presented in Table 1. The reader will notice that most of the major equipment items on this list are of foreign manufacture. At the time of this investigation, there was no U.S. manufacturer of one-half inch video equipment.

Some items of equipment identified in the functional characteristics requirements were not included in the equipment list for the try-out system. The "video to film converter" is an example of an item eliminated. This item was eliminated because there was no equipment item readily available through commercial suppliers. The requirement for converting video information to film format will have to be satisfied by purchasing the service from companies engaged in the activity. Some equipment has been noted as custom made; one example is the "film to video converter". The commercial equipment available in this case did not meet the functional requirements. Equipment components were available to satisfy this function, but they had to be adapted to produce a custom designed item which met the functional requirements. The item designed was called a visual insertion device and was designed to produce video images of slides, movies, and hard copy art work.

Table 1
One-Half Inch Video Equipment List

Item	Manufacturer	Model	Quantity
Video tape recorder	Concord	VTR 820	2
Camera	Craig	6108	3
Lenses			
Manual zoom 10:1	Craig	9836	1
Remote zoom 5:1	Pelco	TV5	1
Remote control	Pelco	LZ5-1	1
Manual zoom 4:1	Craig	9837	2
Tripod	Quick Set	7301	3
Tripod head			
Manual	Quick Set	7230	3
Remote	Pelco	PT550M	1
Remote Control	Pelco	PT1500M	1
Lights	Bardwell McAllister	Bright eyes	4
		Barn Doors	2
Console monitors	Concord	VM 601	6 monitors (2 racks)
Record monitor	Sony	CVM-110U	1
Playback monitor	Electrohome	ETV-6	1
Special effects generator	Shintron	366	1
Sync lock generator	Dynair	SY-290B	1
Video amplifier	Dynair	DA-230A	1
Film to video converter	Custom		1
Microphones	Shure	560	3
Audio mixer	Shure	M-67	1
Audio amplifier	Herald	AM 48A	1
Headsets	Ampex	A-401	4
Headset amplifier	Custom		1
Console cabinets	Emcor	IE #13	2
Recorder cart	Bredford	VTCR 29E	1
Portable cabinets	Telemation	TPC 160	1
		TPC 200	1
Shoulder Pack camera/recorder	Sony	AV 3400-	1
		AVC 3400	1

SECTION V

COMPONENT SELECTION

Methodology

Final selection of equipment items to be assembled for the system tryout was made after price quotations were received from each of the equipment suppliers. Potential suppliers were asked to bid on all items they had recommended, and were not told the results of the equipment evaluations before they bid. The prices of items selected on the basis of the functional requirements and evaluation results were compared to the prices of possible alternate choices. If the price of a selected item was higher than the price of a possible alternate item, the evaluation of capabilities and characteristics of the two items were recompared to determine whether the higher priced item should be selected.

Prices were obtained for both one inch monochrome and one inch color equipment in addition to prices for one-half inch monochrome equipment. Estimated costs of special cabling for interconnecting the components in the various equipment configurations were also obtained.

Results

The cost of a one inch monochrome video tape recorder was approximately three times the price of a one-half inch video recorder ($2,500.00 and $850.00, respectively). The cost of a one inch color recorder was even greater ($5,600.00), and the least expensive color camera cost $9,600.00. The higher initial price of one inch monochrome and color equipment was not the only cost consideration. The cost of one inch video tape was almost twice that of one-half inch video tape (approximately $72.00 per hour and $37.50 per hour, respectively). The higher equipment and materials costs, combined with the lack of recorded tape interchangeability across recorders from different manufacturers, resulted in the one inch monochrome and color formats being judged unacceptable.

The price comparisons among one-half inch video components did not require any changes in the equipment tentatively selected for the tryout system. The greatest difference between the price of equipment items tentatively selected and the price of possible alternate choices was less than five percent. In all cases where the item tentatively selected was more expensive than a possible alternate item, the equipment capabilities and characteristics were judged sufficiently superior to warrent the additional cost.

The complete price list of equipment items and supplies procured for the tryout system is given in Table 2.

Table 2
Price List of Equipment Items and Supplies

Item	Quantity	Manufacturer	Model	Unit Price	Total
Video tape recorder	2	Concord	VTR 820	$ 895.00	$1,790.00
Camera	3	Craig	6180	$ 495.00	$1,485.00
Lenses					
Manual zoom	1	Craig	9836	$ 795.00	$ 795.00
Remote zoom	1	Pelco	TV-5	$ 497.00	$ 497.00
Push rod/zoom	2	Craig	9837	$ 695.00	$1,390.00
Lens remote control	1	Pelco	LZ5-1	$ 189.40	$ 189.40
Tripod w/dolly	3	Quick Set	7301/7601	$ 109.50	$ 328.50
Tripod head					
Manual	3	Quick Set	7230	$ 135.00	$ 405.00
Remote	1	Pelco	PT550M	$ 465.00	$ 465.00
Remote control	1	Pelco	PT1500M	$ 115.00	$ 115.00
Lights w/stands	4	Bardwell McAllister	Bright eyes	$ 55.00	$ 220.00
Lighting accessories	2	Bardwell McAllister	Barn doors	$ 15.00	$ 30.00
Console monitors	2	Concord	VM 601	$ 420.00	$ 840.00
Record monitor	1	Sony	CVM-110-U	$ 207.00	$ 207.00
Playback monitor	1	Electrohome	ETV-6	$ 254.40	$ 254.40
Microphones	3	Shure	560	$ 20.00	$ 60.00
Audio mixer	1	Shure	M-67	$ 134.00	$ 134.00
Headsets w/mike	4	Ampex	MA-401	$ 31.50	$ 126.00
Headset amplifier	1	Electro-service	HA-100	$ 35.00	$ 35.00
Audio amplifier	1	Harold	AM-48A	$ 60.00	$ 60.00
Special effects generator	1	Shintron	366	$ 866.25	$ 866.25
Sync lock generator	1	Dynair	SY 291B	$ 666.00	$ 666.00

Table 2 (Cont'd)

Item	Quantity	Manufacturer	Model	Unit Price	Total
Video amplifier	1	Dynair	DA-230A	$ 168.00	$ 168.00
Film to video* converter					
Cameras	2	Concord	CTC 36	$ 360.00	$ 720.00
Monitors	2	Concord	MR 750	$ 150.00	$ 300.00
Super 8mm projector	1	William Bolex	750	$ 750.00	$ 750.00
Console	1	Custom			
Console cabinets	2	Emcor	IE #13	$ 211.52	$ 423.04
Recorder cart	1	Bretford	VTRC 29E	$ 69.50	$ 69.50
Portable cabinets	1	Telemation	TPC 160	$ 375.00	$ 375.00
			TPC 200	$ 400.00	$ 400.00
Shoulder pack camera/recorder	1	Sony	AV 3400-AVC 3400	$1,395.50	$1,395.50
Cables	Lot	Interconnecting		$2,650.00	$2,650.00
Misc. small parts	Lot			$ 436.50	$ 436.50
Freight and tryout	Lot	Custom		$1,473.91	$1,473.91
				Total for System -	$20,120.00

*This device was the custom designed Visual Insertion Device. The total price for this device included the cost of the items shown ($1,770.00) plus the cost of a random access slide projector and the console cabinet. These last two items were supplied by the Air Force.

SECTION VI

SYSTEM CONFIGURATIONS

Methodology

The situations for which configurations should be developed were identified by reviewing the data collected during the applications analysis and the equipment evaluation phases. The information on techniques used in the past and operations performed provided indications of the combination of equipment items required for each application. Initially, a configuration was developed for each of the operator-combinations. This initial list of system configurations was quite large and it appeared that the system would have to be frequently reconfigured. Frequent system reconfiguration was felt undesirable because the system operating personnel would be inexperienced in these tasks. Further examination of the initial configurations revealed that a reduction in this number could be achieved by assuming multiple operators for most situations. Although this would cause surplus equipment to appear in some configurations, it would eliminate the need for frequent reconfigurations.

The system configurations were developed on paper by listing the equipment items to be used with each combination of number of operators and subjects for the studio and location recording situations separately. Items for studio and location recording were kept separate to identify the number of items and the specific items used in the portable system configurations.

One equipment configuration was tried out at a video seminar conducted by an equipment manufacturer. The equipment employed consisted of two cameras, two camera monitors, a one-inch monochrome video tape recorder, a recording monitor, a special effects generator, an audio mixer, three microphones, four lights, three operator headsets, and all necessary cables. This video system was used to record a three-member panel discussing video system applications. Notes were taken of all operator difficulties, equipment problems, and overall configuration inadequacies. The notes of this experience were used during a

design review of the planned system to aid in identifying potential problem areas. The operational practicability of the configurations was evaluated during system tryout, the last phase of system development.

Results

System configurations were developed for each of the situations listed below.

A. Studio recording

1. Single operator recording self and other subjects
2. Multiple operators titling prerecorded material
3. Multiple operators recording all possible subjects
4. Single operator editing or assembling master tape

B. Location Recording

1. Single operator high mobility required or no 60 Hz power available
2. Single or multiple operators hazardous environment
3. Multiple operators non-hazardous environment
   (Note: In all situations operator(s) are recording other subjects)

C. Playback (Studio or Location)

A compilation of the equipment configurations developed for the recording and playback situations is presented in Table 3. To use the matrix, read across the top and identify the recording situation for which equipment is required. Next, go down the column below the situation and the quantity of each equipment component required is given in the equipment row. No entry in an equipment-situation box indicates the equipment item is not used in the situation. The interconnection wiring of components was developed during Phase VI, System Tryout.

Some equipment items do not appear in the matrix (e.g., headset amplifier). If headsets are used, the amplifier is required, but only one is required regardless of the number of headsets used.

Table 3
Equipment Configuration Matrix

Equipment Items	Studio Recording				Location Recording			
	Single operator Self and subjects	Multiple operators Titling prerecorded material	Multiple operators All subjects	Single operator Edit or assemble tape	Single operator High mobility	Single or multiple operators Hazardous environment	Multiple operators Non-hazardous	Playback
Video tape recorder	1	2	2	2		1	1	1
Camera	3	2	3	2		2	2	
Lenses								
10:1 Manual zoom	1	1	1	1		1	1	
5:1 Remote zoom	1	1	1	1		1	1	
4:1 Manual zoom	1	1	1				1	
Tripod head								
Manual	1	2	3	1		1	2	
Remote	1			1		1		
Lights	4	4	4	4		4	4	
Console monitors	3	5	6	5		3	3	
Record monitor	1	1	1	1		1	1	
Playback monitor		1		1				1
Microphones	1		3	1		2	3	
Audio mixer			1			1	1	
Audio amplifier		1	1					
Headsets		3	4			3	3	
Special effects generator	1	1	1	1		1	1	
Sync lock generator		1		1				
Film uniplexer	1	1	1	1				
Console cabinets	2	2	2	2				
Recorder cart	1	1	1	1		1	1	1
Shoulder pack camera/recorder					1	1	1	
Portable cabinets						2	2	

The equipment configurations indicated in the matrix were used as a starting point during system tryout. Additional configurations were developed as required.

SECTION VII

SYSTEM TRYOUT

Methodology

All system configurations were evaluated during system tryout by actually connecting the components in the indicated configurations and attempting to record the subjects for which the configuration was deemed appropriate. Records were kept of all operating difficulties to help determine required configuration changes. All studio and portable configurations were tried out and were modified during the tryout so that the configurations were finalized at the end of the tryouts.

The normal procedure was to connect the components together with the required cables, perform the system turn-on procedure, video tape the subjects (including special subjects, such as, titles added to prerecorded material), and play back the tape for evaluation. Records were made of cable connections required to accomplish system connection, of equipment turn-on procedures, of operating procedures, of quality achieved in the video recording, and of difficulties encountered during each of these activities. Changes indicated by the difficulties encountered were made immediately and the procedure was repeated until all operating problems were resolved. When one configuration was worked out, the next configuration was tried out following the same approach.

After completing the tryout of configurations planned during Phase V, all records were consolidated and the need for each of the configurations was re-evaluated. Whenever two or more configurations used similar equipment components, combining these components into a single configuration was considered. Factors such as the uniqueness of the system application were considered when making this decision. Whenever two configurations were combined into a single configuration, the new configuration was tried out in all applications in which the separate configurations were previously utilized. A new list of cable connections, procedures, etc. was developed and the new configuration was evaluated in the same manner as its constituent configurations. The tryout process was completed when system configurations were developed for each of the planned applications and further combining of configurations was not feasible because of the unique requirements of each of the system applications.

The records of cable connections, operating procedures, and so forth, were retained and used as source information for three systems manuals: (a) Installation, (b) Operation, and (c) Maintenance. All operating modes for each of the equipment components was included in the Installation and Operation manuals. The Maintenance manual was compiled from separate manuals for each of the equipment items.

Results

A single configuration of operator console equipment was developed for studio recording applications. This configuration is constant except for the particular arrangement of studio cameras connected to the console. Any combination of cameras and video tape playback machines (serving as a camera) can be connected to the console as source information (inputs). The console can handle up to four video inputs simultaneously and will selectively provide fading, wiping, and keying and matting among the inputs. All special effects (e.g., fading, wiping, etc.) can be previewed before being recorded to allow the console operator to adjust the video signal to meet the exact requirements before the signal is recorded on tape. The console is shown in Figure 1. In addition to the video information, audio material from three microphones and one line source can be input into the system and recorded simultaneously with the video or separate from the video. The studio configuration can be operated by one or two or more operators with no change in the system capabilities.

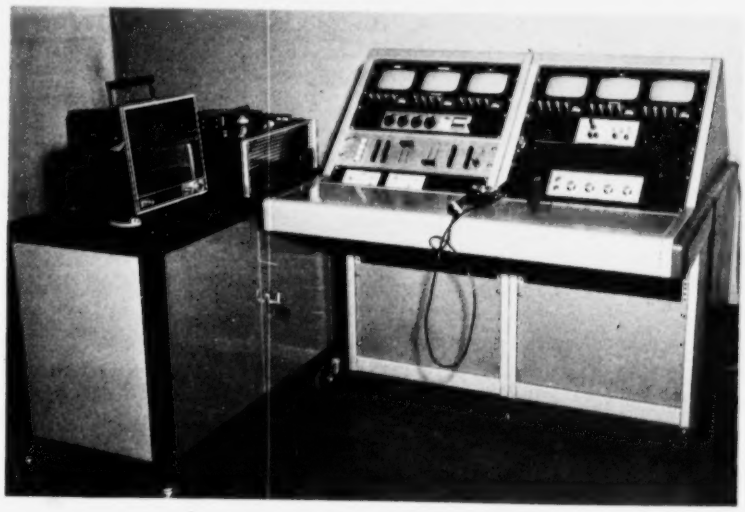

Figure 1. Studio Console.

The console equipment for the studio recording configuration is as follows:

1. Four video input monitors
2. One preview monitor
3. One output monitor
4. One special effects generator
5. One synchronizing signal generator
6. One video distribution amplifier
7. One audio mixer
8. One audio amplifier
9. One video tape recorder
10. One camera intercom system
11. One camera pan-tilt and lens remote control

The studio camera complement includes the following:

1. One camera with remote control pan-tilt base and zoom lens
2. Two cameras with manual control pan-tilt and zoom lens
3. One visual insertion device for generating two simultaneous video images of two different visuals consisting of slides, movies, or hard copy art work
4. One video tape recorder for playback of prerecorded tapes

Only four of the possible six video source equipment items are connected at one time. These equipment items are normally the remote control camera, one manually controlled camera, one-half of the visual insertion device, and the video tape recorder for playback of prerecorded tapes. The other manually controlled camera or the other one-half of the visual insertion device, shown in Figure 2, are connected for special applications. Microphones are connected as required for audio recordings.

Figure 2. Visual Insertion Device.

Two configurations were developed for field location recording. The first of these is for use when very high mobility is required, only one camera is required, and/or 115 volt a.c. power is not available. The second configuration is for use when 115 volt a.c. power is available and more than one camera input is required.

The first configuration provides for recording both video and audio from one camera-microphone combination and playback on the spot to evaluate the quality of the recorded video tape. This configuration consists of a battery operated recorder-camera with a manually controlled zoom lens. The camera is hand held and the recorder is carried in a shoulder-strap case.

The second configuration provides for both video and audio recording. The system can handle two video inputs from two cameras and provides for selective switching, fading, wiping, and keying and matting among these inputs. All special effects can be previewed before being recorded. This configuration provides for audio inputs from three microphones and one line source. The system can be operated by one or two or more operators with no change in system capabilities. The console equipment for this field recording configuration consists of the following:

1. Two video input monitors
2. One preview monitor
3. One video output monitor
4. One special effects generator
5. One synchronizing signal generator
6. One video distribution amplifier
7. One audio mixer
8. One video tape recorder
9. One camera intercom system
10. One pan-tilt and lens remote control

The camera complement of this configuration includes:

1. One camera with remote control pan-tilt base and zoom lens
2. One camera with manual control pan-tilt and zoom lens

The equipment used in this field recording configuration is taken from the studio console and placed in mobile console cabinets. Utilization of this configuration de-activates the studio recording configuration.

The installation and operation manuals contain illustrated procedures for the studio and field recording configurations. The maintenance manual contains instructions for each equipment item. The installation manual contains illustrated procedures for both the studio and field configurations for installing equipment components in the console cabinets and for connecting interconnection wiring which is not changed unless the configuration is changed from the studio to the field configuration or visa versa. The operation manual contains illustrated procedures for connecting cameras and operating the equipment components used in each configuration. The procedures were organized and sequenced in the order the operator would turn on and operate the separate equipment components. Normal procedures were covered first and special procedures were covered later in the sequence. In the case of the procedures associated with the special effects generator, the simpler procedures were covered first and the more complex or sophisticated procedures were covered last. All operating procedures were referenced to the application for which the system was being used.

SECTION VIII

SUMMARY

A video system for the rapid generation of learning sequences was developed in six phases. An analysis of the planned application of the system was performed to determine the system functional characteristics requirements. In Phase II, functional requirements identified in Phase I were compared against equipment item specifications to identify specific equipment items in each of three video recording formats suitable for inclusion in the video system. Two evaluations were conducted in Phase III. The first was performed to determine the format most suitable for the rapid generation of learning sequences. The second was an evaluation of equipment items from the selected format to determine the specific items most suitable in terms of quality of video recording, ease of equipment operation, and other human factors considerations. In Phase IV, components were selected for inclusion in the system on the basis of the evaluations conducted in Phase III and equipment costs. In Phase V, tentative system equipment configurations were developed for each of the planned applications analyzed in Phase I. Finally, in Phase VI, each of the configurations was tried out and procedures were developed for system installation, system operation, and equipment maintenance.

One-half inch monochrome video tape recording was selected as the format most appropriate for the rapid generation of learning sequences. The system developed included tape recording from four video sources, video recording on a shoulder-pack camera-recorder, and capability for special effects. The specific equipment list is provided in the body of the report. Three basic system configurations were developed which included:

1. Studio recording configuration
2. Field recording configuration
    a. Portable for absence of 115 volt a.c. power
    b. Transportable for multiple camera input

Procedures were developed for installation and operation of the system in all configurations. The procedures were presented in appropriately illustrated manuals. In addition, equipment item maintenance instructions were presented in a consolidated maintenance manual.

APPENDIX A

APPLICATIONS ANALYZED

Generation of Learning Sequences

Scripting (Record only)

Location - Studio

Subjects - Prerecorded video tapes

Slides, films, hand drawn art

Optional Equipment (details to entire item)

People - Individuals (hand movement to entire person)

Groups (two man team operating equipment to five or six person discussion group)

Operators - One - recording self and other subjects

One - recording only other subjects

Two or more - recording other subjects

Operations - A single operator performs as both Console and Camera operator.

Console Operator

Record video and audio subjects

Select single subject or combination of subjects for recording at appropriate time

Add prerecorded material to new tape

Add titles to prerecorded video material

Add or change audio on prerecorded material

Assemble live and prerecorded segments into learning sequence master tape

Camera Operator

Obtain properly lighted video picture of subjects

Change titles, slides, or visuals

Position subjects

Tryout (Playback only)

Location - studio, classroom, or office

Viewers - one to five per monitor

Operator - one

Operations - play tape at normal speed

play tape in slow motion or still frame

adjust video and audio controls on recorder and monitor for proper levels

Revision (Record only)

Location - studio

Subjects - prerecorded video tapes

Operator - one

Operations - Add prerecorded material to master tape

Add or change audio on master tape

Assemble prerecorded segments into new learning sequence master tape

Note: If revision is extensive then subjects, operators, and operations may be the same as for Scripting.

Content Approval (Playback only) - essentially the same as Tryout.

Duplication (Record only)

Location - studio

Subject - Prerecorded video tape

Operator - one

Operations - Playback prerecorded tape and make one to five copies, one at a time

Job Performance Analysis

Recording

Location - Outdoors, shops, and classrooms

Maneuverability required

No 117 v AC 60 Hz power available

117 v AC 60 Hz power available

Hazardous situations at camera location

Subject - Operational Equipment (micro circuit components to entire aircraft)

People - Individuals (hand movement to entire person)

Groups - (two man teams to flight in formation)

Operators - one (mobility required or no 117 v AC 60 Hz power)

one (hazardous situation at camera location, 117 v AC 60 Hz power available)

one or more (117 v AC 60 Hz power available and no mobility requirement)

Operations - Record performance in real time

Record details of equipment manipulations

Record job environment, both video and audio

Assemble segments into master tape

Note: Desirable to record some job performance in compressed time (elapsed time recording)

Playback

Location - studio

Viewers - one to five per monitor

Operators - one or viewer

Operations - Play tape at normal speed

Play tape in slow motion or still frame

Note: Normal speed will be fast motion if tape recorded in elapsed time

Testing of Job Performance

Recording - recording for test purpose same as for performance analysis

Playback

Location - work station (outdoors, shop, office)

Viewer - one (test on individual basis with portable equipment)

One to five per monitor (test on group basis only if 117 v AC 60 Hz power available)

Operator - one or viewer

Operations - Play tape at normal speed

Play tape in slow motion or still frame

Adjust video and audio controls on recorder and monitor for proper levels

Note: Recording and Playback may be intermixed in testing application.

Formal Presentations

Recording

Location - studio

Subjects - Prerecorded video tapes

Slides, films, hand drawn art

People - Individuals (hand movement to entire person)

Groups (single group member to five or six persons)

Operators - One - recording self and other subjects

One - recording other individual subjects

Two or more - recording other subjects

Operations - One operator performs as both Console and Camera operator.

Console Operator

Record video and audio subjects

Select one or a combination of subjects for recording at appropriate time

Add prerecorded material to new tape

Assemble live and prerecorded segments into presentation master tape

Camera Operator

Obtain properly lighted video picture of subjects

Change slides or visuals

Position subjects

Playback - same as for Tryout

Informal Letters

Recording

Location - studio

Subjects - Prerecorded video tapes

Slides, films, hand drawn art

People - hand movement or individual to entire person

Operator - one, recording self and other subjects

Operations - Record video and audio subjects

Select one or a combination of subjects for recording at appropriate time

Add prerecorded video material to tape

Add or change audio of prerecorded material

Assemble segments into letter

Playback - same as for Tryout

APPENDIX B

EQUIPMENT FUNCTIONAL CHARACTERISTICS

Studio Equipment

Video Tape Recorder:

Video Input - 1 v p-p, neg sync, 75 ohm impedence composite video signals (standard)

Video Output - 1 v p-p, neg sync, 75 ohm impedence composite video signals (standard)

Record Time - 60 minutes

Audio Input - High impedence

Microphone Input - High impedence

Audio Output - .1v RMS 600 ohm line (OVu)

Operator controls - Function switch
- Rewind
- Stop
- Forward
- Fast Forward

Record Button

Edit Button

Slow Motion - Still lever and control

Video level - Auto or manual w/VU meter

Audio level - Auto or manual w/VU meter

Special Capabilities - Electronic Assemble Editing (Record)

Audio Dubbing (Record)

Still Frame (Playback)

Variable Slow Motion (Playback)

Manual Tracking and Skew control (Playback)

Power - 117 v AC 60 Hz

Number in system - Two

Camera:

Input - subjects in normal classroom illumination

Output - 1 v p-p, neg sync, 75 ohm impedence composite signal (standard)

Monitor - 3" minimum on camera

Lens mounts - standard C mount

Tripod mount - standard 1/4-20 screw

Operator controls - Power switch

Electronic focus

Target control w/automatic pedestal

Contrast, brightness, vertical hold, horizontal hold for monitor

Connectors - video - UHF connector

Sync input and output - UHF connector

Special Capabilities - 2:1 RS 330 sync generator in camera (line lock)

2:1 RS 170 sync input from external generator

Sync signals switchable input and output

Vide tube protected against lost sync

Power - 117 v AC 60 Hz

Number in system - Three

Lens:

Zoom - 10:1, 15-150mm, manual operation

5:1, 20-100mm, remote operation of zoom, focus, iris w/controls rack mounted

5:1, 20-100mm, manual operation

Macro - 25mm, manual operation

Number in system - one of each

Tripods:

Medium duty with dolly

Number in system - Three

Tripod Heads:

Cam link, manual control of Pan and Tilt

Motorized, remote control of Pan and Tilt w/controls for for rack mounting

Number in system - Three - Cam link, one-motorized

Lights:

Quartz Iodide lights with metal bodies, focus control for spot or area light, handle for positioning light, and barn doors

Folding stands that extend to at least eight feet high

Carrying cases for three lamps and stands

Number in system - Six lamp and stand combinations
Three barn doors for lamps
Two carrying cases

Console Monitors:

Five inch, rack mounted, three monitors per rack

Input - 1 v p-p, neg sync, 75 ohm signal (standard)

Output - 1 v p-p, neg sync, 75 ohm signal (standard)

Controls - Power, brightness, contrast, vertical hold, horizontal hold

Power - 117 v AC 60 Hz

Number in system - Six monitors (two racks)

Recorder Monitor:

18 inch monitor/receiver

Video input - 1 v p-p, neg sync, 75 ohm signal

Audio input - 600 ohm line

Antenna input - 300 ohm line

Video output - 1 v p-p, neg sync, 75 ohm signal

Audio output - High impedence

Controls - Standard UHF and UHF tuner

Volume control/power switch

Brightness, contrast, vertical hold, horizontal hold

Power - 117 v AC 60 Hz

Number in system - One

Playback Monitors:

23 inch monitor/receiver

Other characteristics same as 18 inch monitor

Number in system - One

Microphones:

Lavalier microphones - dual impedence

Standard Canon plugs

Stand adapter

Number in system - Three

Audio Mixer:

Four inputs - dual impedence, gain control on each input

Line output - 600 ohm

Master gain control and VU meter

Tone oscillator for calibration

19 inch rack mounting

Power - 117 v AC 60 Hz

Number in system - One

Audio Amplifier:

Line input - 600 ohm

Outputs - speaker 4, 8, and 16 ohms

Power - 117 v AC 60 Hz

Number in system - One

Speakers:

8 ohm

Number in system - Two

Headsets:

DC power supply - voice filtered

Power input - 117 v AC 60 Hz

Special Effects Generator:

Four standard video inputs

Vertical interval switcher

Fades

Vertical and horizontal wipes

Corner inserts

Keying and matting

Controls - Push buttons for switching

Levers for fades and wipes

Switch to select key or matte

Preview - Standard video output to monitor from special effects section

Input - Standard sync and video inputs

Output - Standard video signal to monitor or recorder

Connectors - Standard UHF

Mounting - Standard 19 inch

Power - 117 v AC 60 Hz

Number in system - One

Sync Lock Generator:

Input - Standard composite video signal

Outputs - Vertical sync pulses, neg 4 v p-p, 75 ohm

Horizontal sync pulses, neg 4 v p-p, 75 ohm

Blanking sync pulses, neg 4 v p-p, 75 ohm

Composite sync pulses, neg 4 v p-p, 75 ohm

Connectors - Standard UHF

Power - 117 v AC 60 Hz

Number in system - One

Film to Video Converter:

Position slide projector, movie projector, and video camera

Provide for pointer in visual

Provide for marking visual

Input - Super 8 and 16mm movies, 35 and 126mm slides

Output - Standard composite video signal

Controls - Those on projectors and video camera

Power - 117 v AC 60 Hz

Number in system - One

Video to Movie Converter:

Provide video input for movie camera

Input - Standard composite video signal

High resolution

Synchronous movie camera

Output - exposed film, 16mm or Super 8

Controls - Video monitor and camera

Power - 117 v AC 60 Hz

Number in system - One

Console Cabinets:

Slope top, metal with power connectors

Standard rack mount

Table height 36 inches

Number in system - Two

Cart for Recorder:

Low cart for recorder operation when operator seated

Top large enough for two recorders

Storage space on bottom of cart

Number in system - One

Portable Equipment

Shoulder Pack Camera/Recorder:

Camera - Input - Subjects in normal classroom illumination

Output - 1 v p-p, neg sync, 75 ohm, composite video signal

Monitor - 1 inch minimum on camera, picture in standby mode

Lens Mount - Standard C

Tripod mount - removable pistol grip

Controls - Start-stop trigger on pistol grip

Connector - Locking connector from recorder

Special Capabilities - 2:1 RS 330 sync internal.
microphone mounted on camera

Power - 12 v DC
117 v AC 60 Hz with adapter

Recorder - Video Input - 1 v p-p, neg sync, 75 ohm,
composite video signal

Microphone Input - High impedence

Operator Controls - Function switch
Off - Record - Standby

Optional Functions - Rewind, Play, Fast Forward

Power - 12 v DC rechargable batteries in
recorder with battery charger

117 v AC 60 Hz with adapter

Lens - 5:1 zoom, 15-75mm, C mount

Weight - 25-30 lbs. maximum

Number in system - One Camera/Recorder with Lens

Recorder:

same characteristics as studio Recorder

Number in system - Two

Camera:

same characteristics as studio Camera

Number in system - Two

Lenses:

Zoom - 10:1, 15-150mm, manual operation

5:1, 20-100mm, remote operation of zoom, focus, and iris w/controls rack mounted

Macro - 25mm, manual operation

Number in system - One of each

Tripods:

Medium duty with dolly

Number in system Two

Tripod Heads:

Cam link, manual control of Pan Tilt

Motorized, remote control of Pan and Tilt w/controls, rack mounted

Number in system - Cam link, Two
Motorized - One

Lights:

same as studio Lights

Console Monitors:

same characteristics as studio Console Monitors

Number in system - Three monitors (one rack)

Recorder/Playback Monitor:

same as studio Recorder Monitor

Microphones:

same as studio microphones

Audio Mixer:

same as studio Audio Mixer

Special Effects Generator:

same as studio Special Effects Generator

Cabinets:

Portable rack mount cabinets with covers

Number in system - Two

APPENDIX C

EQUIPMENT FOR EVALUATION

One-half Inch Monochrome

Video Tape Recorders	Concord	VTR 820
	Craig	6407
		6408
	Panasonic	NV-3020 SD
	Sony	AV 3650
Cameras	Concord	TCM 20
		TCM 20 E
	Craig	6108
	Panasonic	WV-350P
	Sony	AVC 3210
Lenses		
Manual Zoom 10:1	Cannon	V8X15
	Craig	9836
	Pelco	M-V 10X15
Remote Zoom 5:1	Pelco	TV5/LZ5-1
(4:1)	Vicon	V25-100m/V100e
	Zoomicon	1-V-V/2CCIA
Manual Zoom	Craig	9837
	Vicon	V25-100
	Pelco	M-5
Tripod w/dolly	Quick Set	7301/7601
	Telemation	CM-2100 (includes head)
Tripod Heads		
Manual	Quick Set	7230
	Telemation	CM-2100 (on tripod)
Remote Control	Pelco	PT550M/PT1500M
	Vicon	V300QT/V110PT

Lights w/stands	Bardwell	
	Mc Allister	Bright eyes kit
	Colortan	Mini Pro kit
	Smith Victor	K2
		K3
Console Monitors	Concord	VM 601
	Panasonic	WV 7063P
	Setchel Carlson	5M916 RM3
	Shibaden	VM-502-3RM
Record Monitor	Craig	6201
	Electrohome	EVM-11
	Sony	CVM-110-U
Playback Monitor	Admiral	E-2216-T
	Electrohome	ETV-6
	Magnavox	T-5906
		T-5916
Microphones	Shure	560
		545L
Audio Mixer	Shure	M67
		M68
Audio Amplifier	Ceavco	CMA
	Electro service	AA-100
Headsets w/mike	Bauer	OH-1
	Sony	DR-10
	Telex	CS 75
	Trimm	
Headset Amplifier	Ceavco	PS-PR10
	Electro service	HA-100
	Video Aids	PLS-1 & PL-1
Special Effects Generator	Shintron	366
	Sony	SEG-1
	Viscount	5V2FE
Sync. Lock Generator	Dynair	Mini Series (SY 291B)

Film Uniplexer	Telemation	TMM 203A TMU 100 TMU 101
Console Cabinets	Emcor Telemation	IE #13 TM-FR-71A
Recorder Cart	Bretford Wilson	VTRC 29E VTR Center
Portable Cabinets	Telemation	TPC 160 TPC 200
Shoulder Pack Camera/Recorder	Concord Panasonic Sony	VTR 450T NV-3080/WV-8080 AV 3400/AVC 3400

Note: No video to film converter available.

One Inch Monochrome

Video Tape Recorders	Ampex	VR 5100 VPR 5200 VPR 5800 VPR 7900

Note: All remaining equipment same as for one-half inch Monochrome except no Shoulder Pack Camera/Recorder available in one inch Monochrome format.

One Inch Color

Video Tape Recorder	Ampex	VPR 5800 VPR 7900
Cameras	RCA Shibaden RCA	PK 730 FPC-1000 PK 430/MI599071

Lenses
Tripod
Tripod Heads
Lights
Console Monitors

} same as for one-half inch Monochrome

Record Monitor	Conrac	KHA 19/C
	RCA	PXC 19
	Magnavox	T 980
Playback Monitor	Magnavox	T 980
Microphones Audio Mixer Headsets w/mike Headset Amplifier Audio Amplifier	same as for one-half inch Monochrome	
Special Effects Generator	Ball	Mark VII B
	Dynair	VS 15 1A
	Telemation	TSE-200
Sync. Lock Generator	3M	Proc Amp
	Ball	Mark 10
	Telemation	GL-2000C
Video Distribution Amplifier Film Uniplexer Console Cabinets Recorder Cart Portable Cabinets	same as for one-half inch Monochrome	
Shoulder Pack Camera/Recorder	Not available in one inch color format	

APPENDIX D

EVALUATION CATEGORIES

SET-UP

Item	# Cables	Ease of Connection	Connectors Differ	Connectors Lock

Set-up:

Item - The equipment designation, manufacturer and model number, was recorded in this column

Cables - The number of cables connected to the equipment were recorded, ex. power cable, video in, video out, number three.

Ease of Connection - Easy or hard was recorded for each connection. Considerations were accessability and connector positioning cues.

Connector Differ - Yes or no was recorded for each connector. A "no" was recorded if two connections used the same connector for different functions.

Connector Lock - Yes or no was recorded for each connector. "Yes" was recorded if the connector could not be pulled out by pulling on the cord.

OPERABILITY

Item	# Cntl.	Ease of Operation	Confusion Poss. Indiv/System	Ind/Func.

Operability:

Item - The equipment designation, manufacturer and model number, was recorded in this column for each type of evaluation.

Cntl. - The number of operator controls was recorded in this column.

Ease of Operation - Easy or hard was recorded for each control. "Easy" was recorded if a control operated as expected, ex. rotating knob cw increased signal, pushing push button activated equipment, releasing stopped it, etc.

Confusion Poss. - Yes or no was recorded for each control. "Yes" was recorded if two similar controls had to be operated differently to obtain the same result, ex. one knob turn cw, another ccw to increase signal. "Yes" was recorded if two controls on an equipment item or two controls on different equipment items in a system operated differently.

Ind/Func. - Yes or no was recorded for each control indicator combination. Yes was recorded for each control which had an indicator to show operator effect of control movements, ex. VU meter for audio and video gain controls, record light for record and edit, etc.

MAINTAINABILITY

Item	# Oper.	Ease of Performance	Poss. of Damage	Possible Seriousness if Damaged	Correction if Damaged

Maintainability:

Item - The equipment designation, manufacturer and model number, was recorded in this column for each type of evaluation.

Oper. - The number of operator maintenance tasks required was recorded.

Ease of Performance - Easy and hard was recorded for each maintenance task. "Easy" was recorded if items to be maintained were accessable, only standard tools were required, and no special training was required.

Poss. of Damage - Low or high was recorded for each maintenance task. "Low" was recorded if incorrect performance would not damage the machine or prevent it from operating properly.

Possible Seriousness if Damaged - a qualitative comment of extent of operability after damage was recorded for each task having high possibility of damage.

Correction if Damaged - Replace or repair was noted for each maintenance task. "Replace" was recorded if non-technician operator could replace a part. "Repair" was recorded if equipment had to be sent to a shop to be put back into operation.

VERSATILITY

Item	Signal	Mountings	Inputs Std.	Outputs Std.	Color Compat.	Cable Exten.	# equip. driven

Versatility:

Item - The equipment designation, manufacturer and model number, was recorded in this column.

Signal - Standard or non-standard was recorded for type of signal processed. Video signal 525 line field, 30 frame is standard.

Mountings - Standard or non-standard was recorded for tripod mounts, lens mounts, rack mounts, etc.

Inputs Std. - Yes or no was recorded for all signal inputs.

Outputs Std. - Yes or no was recorded for all signal outputs.

Color Compat. - Yes or no was recorded for each equipment item in all formats. "Yes" was recorded if equipment would record, pass, or process color video and any adaptors required were listed.

Cable Exten. - Length of cable extensions possible without degrading signal was recorded.

Equip driven - For each camera, recorder, monitor, and special effects generator, the number of equipment items which could be supplied with a signal without intervening amplifiers was recorded.

PORTABILITY

Item	Wt.	Size	Packaging Time/Diff	# Cont.

Portability:

Item - The equipment designation, manufacturer and model number, was recorded in this column for each type of evaluation.

Wt. - The weight in pounds of each item was recorded.

Size - The overall size (height x width x depth) of each item was recorded.

Packaging Time/Diff - Qualitative statements of the packaging difficulty and estimates of packaging time were recorded.

Cont. - The number of containers required to package each item were recorded.

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13. ABSTRACT

The objective of this program was to develop and evaluate an improved portable video system for use as an instructional software design tool. The initial system was designed for use by personnel engaged in research and development in training techniques. It greatly increased the effectiveness and reduced the cost of producing experimental audio-visual materials (e.g. slides, movies, etc.) by providing increased flexibility in scripting, editing, and content review prior to hard copy and permanent recording.

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